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(11) **EP 0 653 090 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

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|--|---|
| (45) Date of publication and mention of the grant of the patent:<br><b>18.11.1998 Bulletin 1998/47</b> | (51) Int Cl. <sup>6</sup> : <b>G06F 1/16, G09G 1/00, G09G 3/00</b>                        |
| (21) Application number: <b>93918572.4</b>   | (86) International application number:<br><b>PCT/US93/07246</b>                           |
| (22) Date of filing: <b>26.07.1993</b>   | (87) International publication number:<br><b>WO 94/02930 (03.02.1994 Gazette 1994/04)</b> |

(54) **REMOVABLE COMPUTER DISPLAY INTERFACE**  
**ABNEHMBARE SCHNITTSTELLE FÜR RECHNERBILDSCHIRM.**  
**INTERFACE AMOVIBLE POUR AFFICHAGE INFORMATIQUE**

<p>(84) Designated Contracting States: <b>AT CH DE FR GB LI NL</b></p> <p>(30) Priority: <b>27.07.1992 US 918966</b></p> <p>(43) Date of publication of application: <b>17.05.1995 Bulletin 1995/20</b></p> <p>(73) Proprietor: <b>ELONEX TECHNOLOGIES, INC.</b> <b>San Mateo, CA 94401 (US)</b></p> <p>(72) Inventors: • <b>MORICONI, David, P.</b> <b>Ben Lomand, CA 95005 (US)</b></p>	<p>• <b>KIKINIS, Dan</b> <b>Saratoga, CA 95070 (US)</b></p> <p>(74) Representative: <b>Hillier, Peter et al</b> <b>Reginald W. Barker &amp; Co.,</b> <b>Chancery House,</b> <b>53-64, Chancery Lane</b> <b>London, WC2A 1QU (GB)</b></p> <p>(56) References cited:</p> <table><tr><td><b>US-A- 4 794 381</b></td><td><b>US-A- 4 870 531</b></td></tr><tr><td><b>US-A- 4 939 652</b></td><td><b>US-A- 4 980 678</b></td></tr><tr><td><b>US-A- 5 103 377</b></td><td><b>US-A- 5 138 305</b></td></tr><tr><td><b>US-A- 5 138 565</b></td><td><b>US-A- 5 166 893</b></td></tr></table>	<b>US-A- 4 794 381</b>	<b>US-A- 4 870 531</b>	<b>US-A- 4 939 652</b>	<b>US-A- 4 980 678</b>	<b>US-A- 5 103 377</b>	<b>US-A- 5 138 305</b>	<b>US-A- 5 138 565</b>	<b>US-A- 5 166 893</b>
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<b>US-A- 5 138 565</b>	<b>US-A- 5 166 893</b>								

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**EP 0 653 090 B1**

## Description

This invention is in the field of architecture of portable computers, and pertains in particular to apparatus and methods of interfacing removable physical displays to portable computers.

The marketplace for portable computers, such as notebook and laptop computers, is one of the faster growing sectors of the computer industry. There are many challenges in developing and designing computers of this sort, many of which are a result of need for light weight, strength, and longevity of portable power sources.

Another area of innovation in the development of portable computers is driven by the facts of use of portable computers as compared to stationary models. Portable computers have to operate under a variety of conditions. For example, while a stationary model, such as a desktop computer, is typically used at a single location under relatively constant lighting conditions, a portable computer must be usable under a variety of lighting conditions in both indoor and outdoor situations. In some situations it is even preferable to have a display that is usable in bright sunlight.

A portable computer is known from US-A-5103377, comprising a body structure for housing and supporting computer elements, a display means and a mounting structure for pivotally attaching the display means to the body structure. A leg portion of the mounting structure is received by an opening in the body structure, the opening having a cover provided with a cable through hole. The body structure and display means being connected by means of a cable.

In US-A-4794381, an electronic apparatus is disclosed comprising a computer main body including a display portion and keyboard portion, and an external output unit comprising a printer integrally coupled with said computer main body.

There are several different types of computer displays, and many new types being developed, all of which are what are called in the art "flat panel" displays. Flat panel displays are necessary, because the well-known CRT displays are much too bulky and vulnerable to be used extensively for portable applications.

Among the many different types are Transflective displays, which have low back light and low power consumption; standard monochrome paper-white displays, which are back-lit and exhibit moderate power consumption; and passive colour displays, also known as super-twist nematic (STN), which have very good visibility and colour, but exhibit higher power consumption.

There are seen to be, then, many issues one must consider when choosing a display, such as visibility under different ambient conditions, colour availability and range, power consumption, and more. And in the current state-of-the-art, choosing the display is akin to choosing the computer, because most computers are not provided with a range of choices in display.

What is clearly needed is a portable computer with a physical interface for attaching and detaching a display panel, and a means of recognizing on power-up the specific display attached.

The invention provides a modular display as claimed in claim 1.

In a preferred embodiment, modular displays for use with a computer configured to accept them have a code stored in a memory device, such as an EEPROM, for identifying the type of display, which is accessed by the computer memory and matched with a compatible display driver routine for operating the display, which the computer then uses. Newly developed displays may then be used with computers previously manufactured and sold, by updating the computer BIOS and providing suitable drive routines for such newly developed displays.

The invention also provides a general-purpose computer as claimed in claim 4.

In a preferred embodiment of the invention a computer system is provided having a body structure that houses and supports computing elements, memory elements and input elements. The display for the system is provided as a removable flat-panel display module which has physical and electrical joining elements for attaching to the body structure of the computer. The attachment is made to a mounting structure that is hinged to the body structure along a pivot axis, and the mounting structure has corresponding physical and electrical joining elements to engage those provided on the display module. The physical and electrical joining elements are aligned to join and disjoin by motion in the direction of the pivot axis, which provides for secure attachment in the event a user lifts the computer by the display module.

In a preferred embodiment the physical mating elements comprise engaging rails with an engaging direction parallel to the pivot axis of the mounting structure, and a snap-in structure having a matching slot and a disengagement pushbutton comprising a releasable detent mechanism. The electrical connection is made in this preferred embodiment by a multi-pin connector engaging and disengaging in the same direction as the engagement rails.

The invention will now be described by way of example and with reference to the accompanying drawings, in which:-

Fig. 1 is an isometric view of a portable computer according to the invention with a removable modular display.

Fig. 2 is an elevation view of a modular display according to an embodiment of the invention, assembled to a mounting structure.

Fig. 3A is a view of the same components as shown in Fig. 2, but with the modular display disjoined from the mounting structure.

Fig. 3B is a cross-section view through guide and engaging taken along section line 3B-3B of Fig. 2.

Fig. 3C is an elevation view of a latching mechanism employed in an embodiment of the invention.

Fig. 4 is a block diagram depicting an arrangement of elements of a computer according to an embodiment of the invention, used for initializing the computer to operate the modular display.

Fig. 5 is a pin-out listing for a multi-pin electrical connector in a preferred embodiment.

Fig. 1 is an isometric view of a notebook computer 11 with a removable, interchangeable display module 13 according to an embodiment of the present invention, allowing a variety of different types of display modules to be used with the same computer apparatus simply by removing one display module and substituting another. Notebook 11 also comprises a keyboard 15 and a body portion 19. Display module 13 is shown in the "open" position, but may be rotated "closed" over the keyboard, where it may be secured by conventional latching mechanisms.

In the embodiment shown in Fig. 1, display module 13 is configured to attach to a hinged mounting structure 17, having an "L" shape, which remains with the computer when display module 13 is removed. The hinges between body portion 19 and mounting structure 17 are not seen in Fig. 1, and may be accomplished in a number of conventional ways. In a preferred embodiment, the hinge mechanisms are pre-loaded to provide sufficient friction to allow the display, if released at any partially open position, to remain in that position.

Fig. 2 is a face-on view of the notebook computer in the direction of arrow 21 of Fig. 1, showing more detail of the unique mounting of display module 13 to mounting structure 17 according to the present embodiment of the invention. The unique mounting configuration provides for display module 13 to approach and engage mounting structure 17 from one side, in this case from the left, and to be removed also from the side, in the direction of arrow 23. Fig. 2 shows the display module fully engaged.

Fig. 3A is a view of the notebook computer from the same vantage as in Fig. 2, but showing the display module fully disengaged from mounting structure 17. In this embodiment there are three sets of linearly engaging guides for guiding the display module into engagement, and for providing structural rigidity when engaged. Guides 25 and 26 are one set, guides 27 and 28 another set, and guides 29 and 30 a third set. Three sets have been found to be convenient. There could be one, two, or more than three sets of guides in other embodiments.

Fig. 3B is a section taken through the engaging guide set comprising guides 25 and 26 to better illustrate the details of engagement. In this embodiment guide 25 has a T-shape, and guide 26 has a C-shape, such that the T-shape of guide 25 fits snugly within the C-shape of guide 26. The engaging shapes of the other guide sets follow the same detail as the set shown.

Although not shown in the Figs. provided, the leading end of T-shaped guides are tapered for easy entry into the C-shaped guides. Also, there is no necessity for

one sort to be attached to the display module and the other to the mounting structure.

Mounting structure 17 has a vertical portion 18 at one end, and display module 13 has a cut-out area 31 of the same shape and size as vertical portion 18, so when the display module is fully engaged with mounting structure 17 the two form a rectangular assembly. A snap-in structure 32 fixedly attached to display module 13 extends into cut-out area 31, and aligns with and engages an engagement slot 33 in vertical portion 18 of mounting structure 17 when the display module is fully engaged.

Fig. 3C shows additional detail of snap-in structure 32 and engagement slot 33. Structure 32 is injection moulded plastic in the embodiment shown, and includes a cantilevered spring-lever 34 with a snap-in shoulder 35. Slot 33 has a shoulder 36 which engages shoulder 35 on structure 32 when fully assembled, firmly locking display module 13 into structure 17. A spring-loaded button 37 is configured to deflect cantilever spring 34 when the button is depressed, allowing disjoining of the display module and the mounting structure.

There is additionally a connector 39 (Fig. 2) with a male (39') and a female (39'') part (Fig. 3A), for communication, power, and control signals between the computer and display module 13.

To remove a display from the computer, one depresses button 37 and slides the display to the side (direction of arrow 23), disengaging snap-in structure 32 and connector 39, while at the same time disengaging the three sets of linearly operating guides mounted across the length of structure 17 and the display module. When the linearly operating guides are disengaged, one may lift the display module away from the computer. To engage the same or another display module, one sets the module in alignment on structure 17 with the matched linear guides adjacent, then slides the module in the direction of arrow 23 to accomplish engagement. The purpose of having plural sets of engaging guides is to minimize the distance one must move the display module to one side when engaging and disengaging.

The particular arrangement shown in Figs. 2, 3A, 3B, and 3C has proven to be advantageous, although there are other arrangements also useful. One could, for example, use round pins aligned with bores to accomplish guiding and engaging. In the embodiment shown the height of portion 18 of structure 17 is about 6 cm., but could extend for the full height of module 13.

A distinct advantage of the sideways engagement and the engaging guides, such as guides 25 and 26, may be easily moved in the engagement direction, but are extremely difficult to separate at a right angle to the engaging direction. The same is true for other engaging devices that might be used, such as pins as mentioned above. One may pick the assembly up by the display module and carry it that way, because the forces from doing so will be at a right angle to the length of the engagement elements, instead of in line with the direction

of disengagement. This is a particular advantage for the notebook computer.

In the embodiment shown power and control connection is made from the computer to display module 13 through the multi-pin electrical connector 39 (Fig. 2), shown as male part 39' and female part 39" in Fig. 3. In the present embodiment there are 40 pins in the connector, although in some other embodiments there might be more or fewer.

As described above, the removable nature of the display module makes it possible to provide a variety of display modules to be used with a single notebook computer. A user may then be offered a number of purchase options. One might desire, for example, to have two display modules, one capable of providing optimum performance under office conditions, and another for outdoor use. The replaceable nature of the display module also allows a user to update to higher performance (and perhaps more expensive) displays at a time after purchase. One also has the option of interfacing displays to the computer that may be developed at a later time.

An additional feature of the invention is an ability on power-up to ascertain the nature of the display module and to provide the correct power and control signals for the assembled module.

Fig. 4 is a block diagram showing the connection of power and control elements in an embodiment of the invention. In this embodiment a display board 41 is incorporated into the computer with connection to the system parallel bus, and having output to 40-pin connector 39 along path 40. Display module 13 comprises a flat-panel display 43, which, in this embodiment is a component obtained from one of several suppliers of flat-panel displays. As is typical in the industry, display 43 comprises "tabs" such as tab 45, which incorporate logic for converting data communication to on-off status for crossed traces that activate bits in the bit-array of the display. In this embodiment the display emulates to 640 column by 480 line standard of VGA displays. Displays in the art come complete with wiring connections and signal requirements, including data format and so forth, so the computer manufacturer using the display may provide the correct operating signals.

The display module also comprises circuitry 47, including an adjustable DC/DC converter 49 and a EEPROM memory device 51 for storing a code associated with the type display with which the EEPROM is associated. Circuitry 47 is connected to connector 39 by path 42, and provides output to display 43 via path 44. The DC/DC converter receives a power trace through the connector, and provides output for contrast voltage and backlighting, which may be adjusted via user signals. This output is part of the signals on path 44 to display 43. In one variation, the contrast and brightness are adjustable by keystroke combinations, and in a more preferred mode, when a pointing device (such as a mouse) is used, the contrast and brightness may be adjusted by movement of the pointing device. In both variations, the

adjustments are software controlled. There may also be input devices, such as familiar slide switches, on the display module to make such adjustments.

In the present embodiment EEPROM 51 is programmed with a unique identity code for the specific type of module. Each type of module offered for the computer has a specific identity code. On initializing, the system BIOS queries the display to ascertain the module type, and loads the correct routines to operate that module. For the situation where a new type or improved display module is introduced, a simple BIOS upgrade allows previously manufactured computers to use the new display module.

Typically communication to the display module to control the bit-map of the display is by 8-bit serial data flow. The protocol for the serial communication, however, is not always the same from manufacturer to manufacturer and for different display types. Hence the EEPROM code for identity, which the computer system uses as a pointer to driver routines to match the particular requirement of the display module. On power-up, as indicated above, the BIOS queries the display module and loads the correct display driver routines.

As a further aid in understanding the circuitry for the present embodiment of the invention, Fig. 5 is provided with the present pin number assignments related to signal identification. In this particular instance, there are two bit streams, one for an upper display, and the other for a lower display, which are not separate displays at all, but upper and lower segments of the one display, driven in parallel to avoid flicker. The 40-pin arrangement has proven to also be sufficient to drive colour displays, which have, generally speaking, three times the dots in the display map as do monochrome displays.

Modifications may be made to the embodiments of the invention described above without departing from the scope of the invention as defined in the appended claim. For example, there are several ways the circuitry might be arranged to accomplish the task of querying the EEPROM in the display module to determine the display type and drive requirements. Likewise, a EEPROM is convenient for storing the identity code at the display module, but is not the only memory device that might be used. There are also a number of alternative arrangements of elements to allow display modules to engage from one side, as described above.

## Claims

1. A flat-panel display module (13) for a computer comprising:

a display screen presented on one surface for displaying computer output; and  
mating electrical connection means (39') for providing display control signals to said display module (13), characterised by

slidable engagement means (25,27,29) mounted along a first edge of said display module for joining said display module to a computer; said slidable engagement means being configured to engage a corresponding slidable engagement means (26,28,30) mounted to a mounting structure (17) pivotally attached along a pivot axis to a body surface (19) of a computer, an engagement direction being parallel to said pivot axis.

2. A flat-panel module as claimed in claim 1, wherein said slidable engagement means (25, 27, 29) comprises at least one engagement rail configured to engage a corresponding rail mounted to said mounting structure (17).
3. A flat-panel display module as claimed in claim 2, wherein said slidable engagement means (25,27,29) comprises at least two of a shaft and matching bore being a part of said display module, configured to engage at least two of a bore and matching shaft being a part of said mounting structure, the engagement direction being the direction of said pivot axis, and engagement being accomplished by moving said display module (13) in the direction of said pivot axis.
4. A general-purpose computer comprising a body structure (19) for housing and supporting computing elements; a flat-panel display means (13) and a mounting structure (17) for pivotally attaching the display means to the body structure, characterised in that:
 

said display means comprises a flat-panel display module (13) as claimed in any one of claims 1 to 3.
5. A general-purpose computer as in claim 4, wherein said mating electrical connection means (39) comprises a first portion (39') of a multi-pin electrical connector mounted in said display module (13), and a second portion (39'') of said multi-pin electrical connector mounted in a portion of said mounting structure (17), said first and second portions (39', 39'') of said multi-pin electrical connector engageable by the motion that engages said first and second slidable engagement means (26 to 30).
6. A general-purpose computer as claimed in claims 4 or 5, further comprising a snap-in structure (32) extending from one of said display module (13) and said mounting structure means (13) and an engagement slot (33) in the other of said display module and said mounting structure means, configured to engage and snap together as said display module and mounting structure means fully engage, there-

by holding said display module firmly in engagement with said mounting structure means.

7. A general-purpose computer as in claim 6 wherein said snap-in structure (32) comprises release means (37) for unlocking to release said display module from said mounting structure means for removal.

## Patentansprüche

1. Flachbildschirmmodul (13) für einen Computer mit
 

einem auf einer Oberfläche vorgesehenen Anzeigebildschirm zum Anzeigen von Computerausgabesignalen; und

einer elektrischen Anschlußeinrichtung (39') zum Anlegen von Anzeigesteuerungssignalen an das Bildschirmmodul (13),

gekennzeichnet durch

- eine verschiebbare Eingriffseinrichtung (25, 27, 29), welche entlang eines ersten Randes des Bildschirmmoduls befestigt ist, zum Verbinden des Bildschirmmoduls mit einem Computer;

wobei die verschiebbare Eingriffseinrichtung ausgeführt ist, um in eine korrespondierende, verschiebbare Eingriffseinrichtung (26, 28, 30) einzugreifen, welche an einer Befestigungsstruktur (17) befestigt ist, die um eine Drehachse schwenkbar mit einer Körperoberfläche (19) eines Computers verbunden ist, wobei die Eingriffsrichtung parallel zur Drehachse verläuft.
2. Flachbildschirmmodul nach Anspruch 1, bei welchem die verschiebbare Eingriffseinrichtung (25, 27, 29) wenigstens eine Eingriffsschiene aufweist, die ausgeführt ist, um in eine korrespondierende Schiene einzugreifen, welche an der Befestigungsstruktur (17) befestigt ist.
3. Flachbildschirmmodul nach Anspruch 2, bei welchem die verschiebbare Eingriffseinrichtung (25, 27, 29) wenigstens zwei Schäfte oder passende Bohrungen oder einen Schaft und eine passende Bohrung umfaßt, die Teil des Bildschirmmoduls sind, welche ausgeführt sind, um in entsprechende Bohrungen oder passende Schäfte einzugreifen, welche Teil der Befestigungsstruktur sind, wobei die Eingriffsrichtung die Richtung der Drehachse ist und der Eingriff dadurch erzielt wird, daß das Bildschirmmodul (13) in Richtung der Drehachse bewegt wird.
4. Computer für allgemeine Anwendungen mit einem

Gehäuse (19) zum Aufbewahren und Stützen von Berechnungselementen, einer Flachbildschirmeinrichtung (13) und einer Befestigungsstruktur (17) zur gelenkigen Befestigung der Bildschirmeinrichtung mit der Gehäusestruktur, dadurch gekennzeichnet, daß die Bildschirmeinrichtung ein Flachbildschirmmodul (13) nach einem der Ansprüche 1 bis 3 aufweist.

5. Computer für allgemeine Anwendungen nach Anspruch 4, bei welchem die elektrische Anschlußeinrichtung (39) einen ersten Abschnitt (39') eines elektrischen Vielfach-Kontakt-Verbinders, welcher an dem Bildschirmmodul (13) befestigt ist, und einen zweiten Abschnitt (39'') des elektrischen Vielfach-Kontakt-Verbinders, der in einem Abschnitt der Befestigungsstruktur (17) befestigt ist, aufweist, wobei der erste und der zweite Abschnitt (39', 39'') des elektrischen Vielfach-Kontakt-Verbinders durch die Bewegung in Eingriff bringbar sind, welche die erste und zweite verschiebbare Eingriffseinrichtung (26 bis 30) in Eingriff bringt.
6. Computer für allgemeine Anwendungen nach Anspruch 4 oder 5, ferner mit einer Einschnappstruktur (32), die sich von dem Bildschirmmodul (13) oder der Befestigungsstruktureinrichtung (17) erstreckt, und mit einem Eingriffsschlitz (33) in dem entsprechend anderen Bildschirmmodul oder der Befestigungsstruktureinrichtung, wobei diese so ausgeführt sind, daß sie ineinandergreifen und zusammenschnappen, wenn das Bildschirmmodul und die Eingriffseinrichtung vollständig ineinandergreifen, wobei diese das Bildschirmmodul fest in Eingriff mit der Befestigungsstruktureinrichtung hält.
7. Computer für allgemeine Anwendungen nach Anspruch 6, in welchem die Einschnappstruktur (32) eine Löseeinrichtung (37) zum Entriegeln enthält, um das Bildschirmmodul zum Entfernen von der Befestigungsstruktureinrichtung zu lösen.

#### Revendications

1. Module d'affichage à panneau (13) destiné à un ordinateur, comprenant :

un écran d'affichage présent sur une surface, afin d'afficher les signaux de sortie de l'ordinateur ; et  
des moyens de connexion électrique (39') par accouplement destinés à fournir des signaux de commande d'affichage au module d'affichage (13),

caractérisé par

un dispositif d'insertion coulissant (25, 27, 29) monté le long d'un premier bord du module d'affichage afin d'assembler le module d'affichage avec un ordinateur ;

le dispositif d'insertion coulissant étant configuré pour s'insérer dans un dispositif d'insertion coulissant (26, 28, 30) correspondant monté sur une structure de montage (17) fixée de façon pivotante, le long d'un axe de pivotement, sur une surface (19) du boîtier d'un ordinateur, une direction d'insertion étant parallèle à l'axe de pivotement.

2. Module à panneau selon la revendication 1, dans lequel le dispositif d'insertion coulissant (25, 27, 29) comprend au moins un rail d'insertion configuré pour s'insérer dans un rail correspondant monté sur la structure de montage (17).

3. Module d'affichage à panneau selon la revendication 2, dans lequel le dispositif d'insertion coulissant (25, 27, 29) comprend au moins deux éléments parmi une tige et un alésage correspondant, faisant partie du module d'affichage, configurés pour s'insérer dans au moins deux éléments parmi un alésage et une tige correspondante, faisant partie de la structure de montage, la direction d'insertion étant la direction de l'axe de pivotement, et l'insertion étant réalisée en déplaçant le module d'affichage (13) dans la direction de l'axe de pivotement.

4. Ordinateur polyvalent comprenant une structure formant boîtier (19) destinée à loger et à constituer le support d'éléments de calcul ; des moyens d'affichage à panneau (13) et une structure de montage (17) destinée à assembler, de façon pivotante, les moyens d'affichage avec la structure formant boîtier, caractérisé en ce que :

les moyens d'affichage comprennent un module d'affichage à panneau (13) selon l'une des revendications 1 à 3.

5. Ordinateur polyvalent selon la revendication 4, dans lequel les moyens de connexion électrique par accouplement (39) comprennent une première partie (39') d'un connecteur électrique multibroches montée dans le module d'affichage (13), et une deuxième partie (39'') du connecteur électrique multibroches montée dans une partie de la structure de montage (17), ces première et deuxième parties (39', 39'') du connecteur électrique multibroches étant susceptibles d'être accouplées par le mouvement qui fait coopérer les premier et deuxième dispositifs d'insertion coulissants (26 à 30).

6. Ordinateur polyvalent selon la revendication 4 ou 5, comprenant, en outre, une structure d'encliquetage

(32) s'étendant entre, au choix, le module d'affichage (13) et la structure de montage (17), et une fente d'insertion (33) présente dans, au choix, le module d'affichage et la structure de montage, configurée pour permettre l'insertion et l'enclenchement lorsque le module d'affichage et la structure de montage coopèrent complètement, maintenant ainsi le module d'affichage fermement en contact avec la structure de montage.

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7. Ordinateur polyvalent selon la revendication 6, dans lequel la structure d'enclenchement (32) comprend des moyens de libération (37) et de déverrouillage afin de libérer le module d'affichage de la structure de montage pour l'en retirer.

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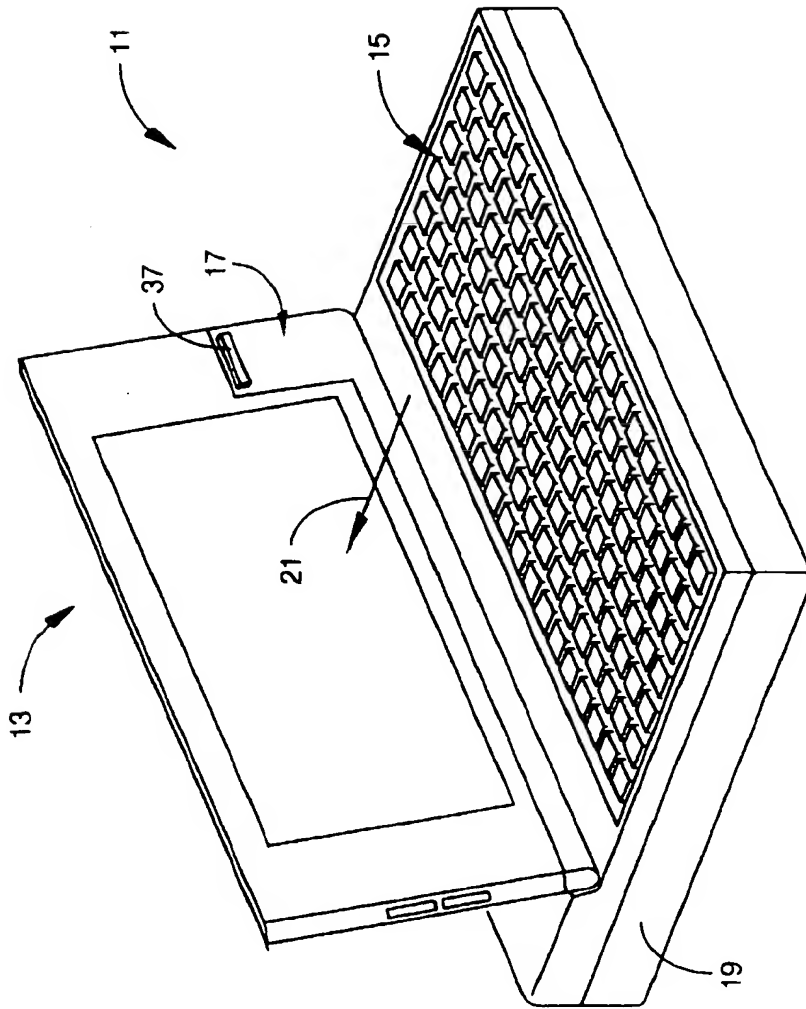


Fig. 1

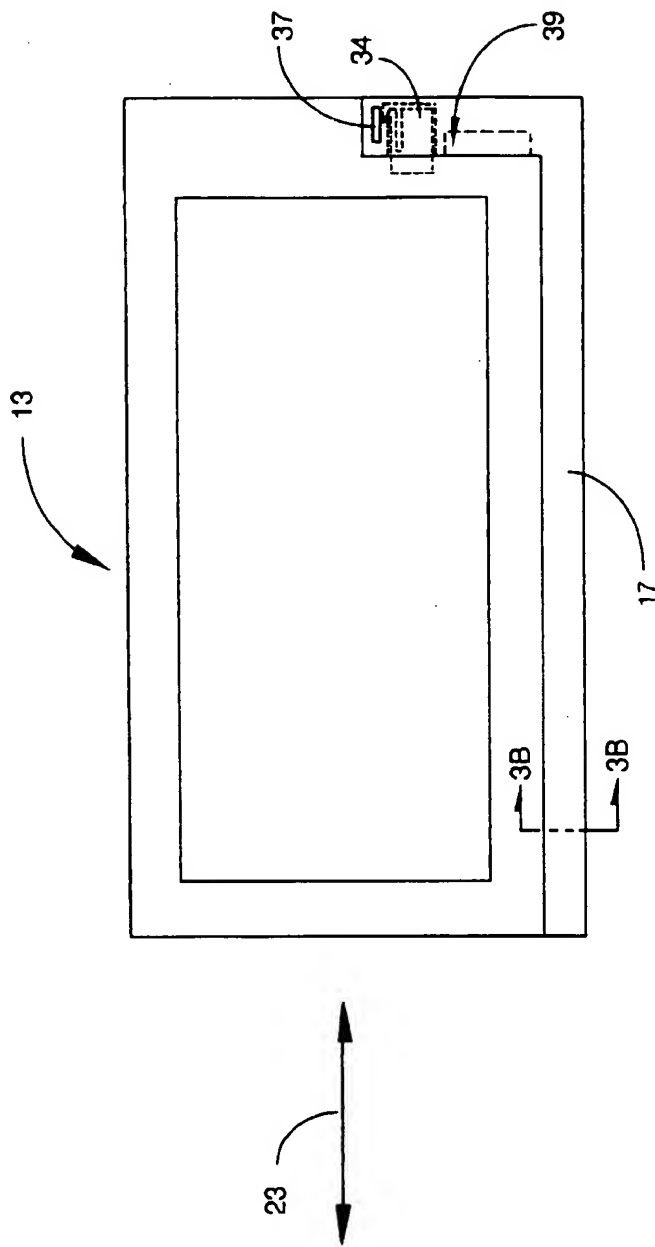


Fig. 2

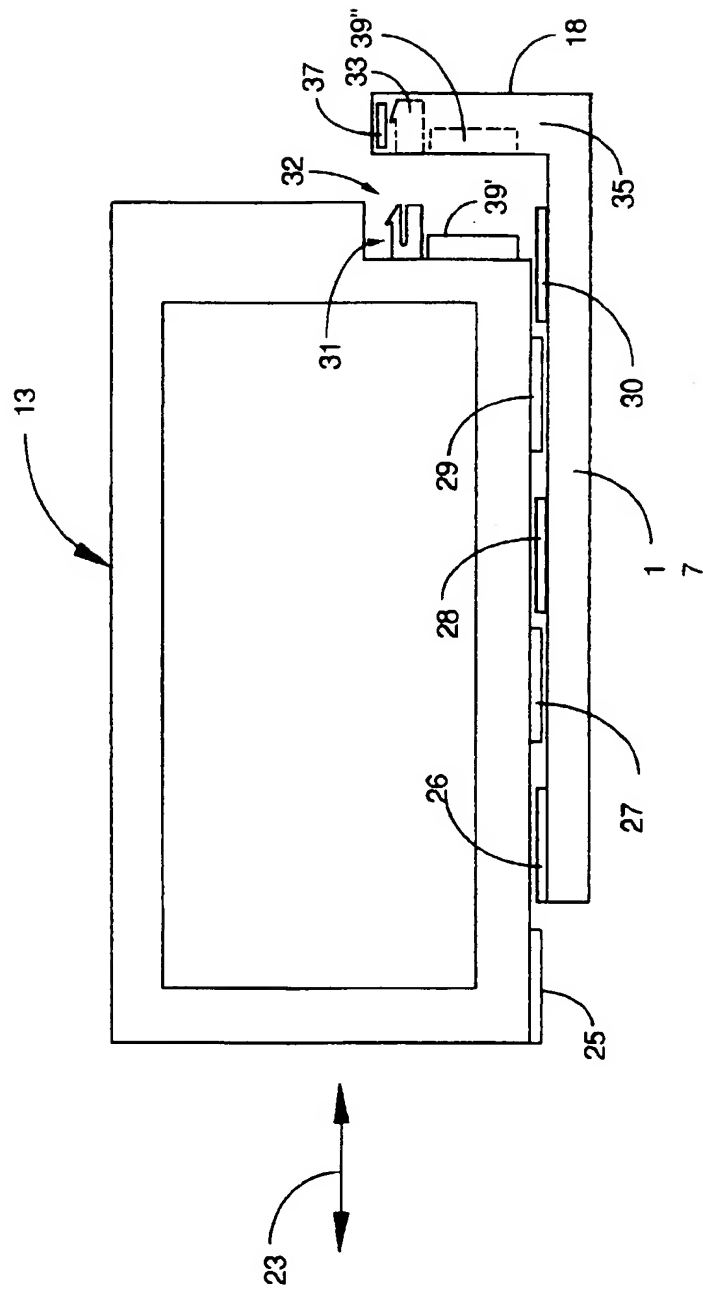


Fig. 3A

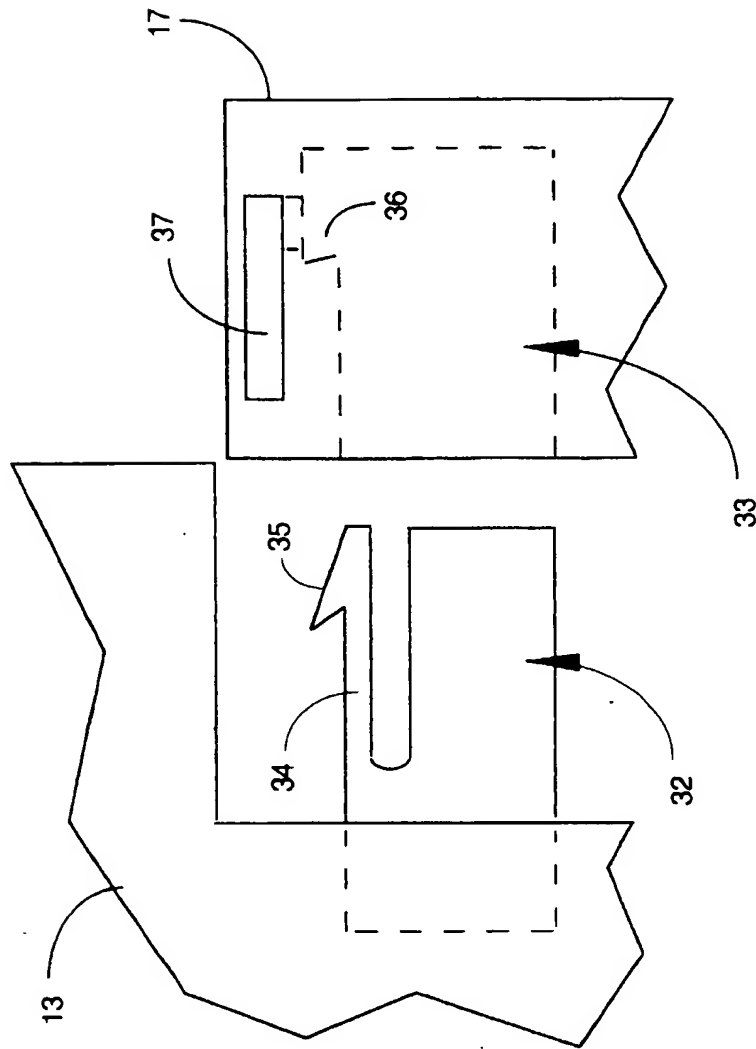


Fig. 3C

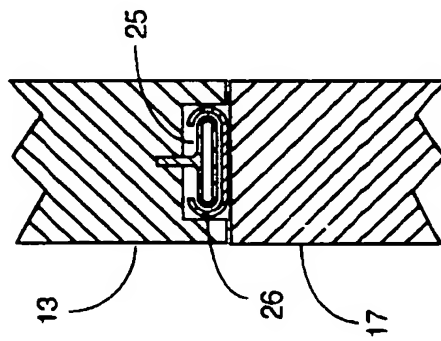


Fig. 3B

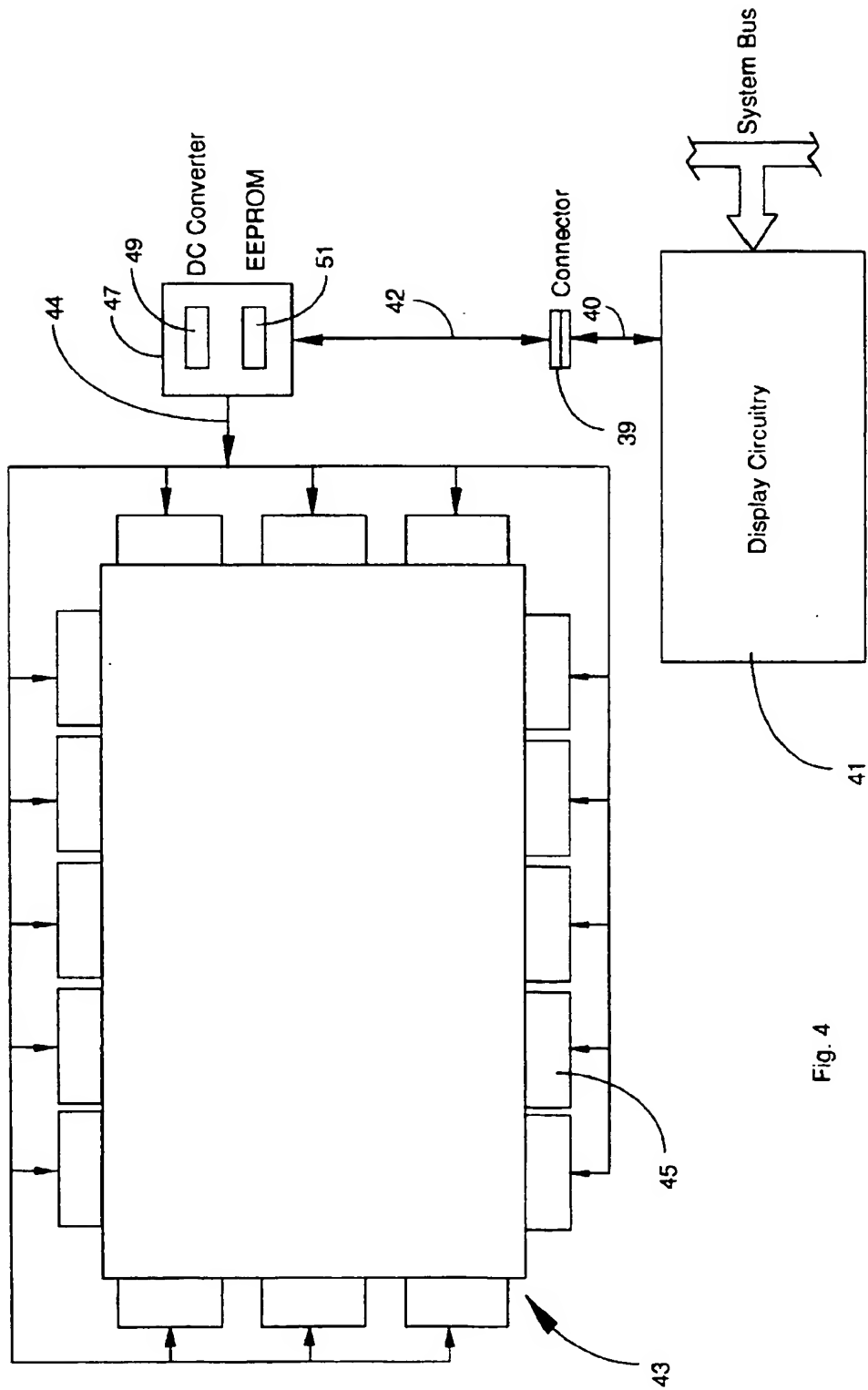


Fig. 4

Fig. 5

## Pin Assignments

No.	Pin	Description
1	VCC	Power to display logic
2	VSS	Ground to display logic
3	VEN	Unused
4	VEP	Unused
5	SDE	Serial I/O to EEPROM
6	SD1	Serial I/O to EEPROM
7	SD2	Serial I/O to EEPROM
8	CF1	Contrast Control (Analog)
9	CF2	Brightness Control (Analog)
10	CF3	Unused
11	CF4	Unused
12	DEN	Display Enable
13	FCL	Frame Clock
14	PCL	Pixel Clock
15	RCL	Row Clock
16	ACL	Modulation
17	UD0	Upper Display Data 0
18	UD1	Upper Display Data 1
19	UD2	Upper Display Data 2
20	UD3	Upper Display Data 3
21	UD4	Upper Display Data 4
22	UD5	Upper Display Data 5
23	UD6	Upper Display Data 6
24	UD7	Upper Display Data 7
25	LD0	Lower Display Data 0
26	LD1	Lower Display Data 1
27	LD2	Lower Display Data 2
28	LD3	Lower Display Data 3
29	LD4	Lower Display Data 4
30	LD5	Lower Display Data 5
31	LD6	Lower Display Data 6
32	LD7	Lower Display Data 7
33	RB	Raw Battery Plus
34	RB	Raw Battery Plus
35	RB	Raw Battery Plus
36	RB	Raw Battery Plus
37	RGBND	Raw Battery Ground
38	RBGND	Raw Battery Ground
39	RBGND	Raw Battery Ground
40	RBGND	Raw Battery Ground